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ABSTRACT

The study was designed to determine whether inferences about implied elements are drawn during sentence comprehension. A cued recall procedure was employed. It was argued, for example, that if one computes the use of a hammer when "the worker pounded the nail" is encountered, that "hammer" should effectively cue the recall of the sentence; while a corresponding low preference instrument, like "rock," should not. In two experiments this pattern of results did not emerge. However, norms that measured the strength of association from instrument cues to their corresponding actions did predict performance. A third experiment examined implied agents and patients as well as instruments, with similar results. It was concluded that the effectiveness of an implicit recall cue does not prove that the corresponding inference had been computed earlier. (Author)

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The Role of Explicit and Implicit Recall Cues in the Study of Inference

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In the present study, a cued recall procedure was applied to the inspection of verb-entailed roles or cases, and the inferences they permit. Other studies that have employed implicit cued recall have demonstrated that words that represent certain implications of antecedent sentences often function as effective recall cues for these sentences (e.g., Anderson & Ortony, 1975; Barclay, Bransford, Franks, McCarrell, & Nitsch, 1974; Paris & Lindauer, 1976; Till, 1977). When a sentence like the sailor swept the floor occurs in acquisition, for example, broom subsequently permits recall. The rationale underlying these investigations has been that if an implicit cue permits the recall of an antecedent sentence, it may be concluded that the corresponding inference has been computed and stored during the original encoding of the sentence. The implicit cue permits recall because it "makes contact" with its token (cf., Anderson, Goetz, Pichert, & Halff, 1977, p. 143) in the internal representation of the corresponding sentence.

The goal of this study was to distinguish among a variety of encoding hypotheses concerning implied roles. The instrument case received the most detailed, though not exclusive, consideration. Implicit instruments have been examined in many investigations, perhaps because there are a relatively large number of actions that suggest highly probable instruments (e.g., Anderson & Ortony, 1975; Charniak, 1975; Clark, 1977; Johnson, Bransford & Solomon, 1973; Kintsch, 1972; Paris & Lindauer, 1976; Singer, in press). These investigations have provided evidence on both sides of the issue of whether the language recipient infers and stores implicit instruments during encoding. In support of this position, it has been shown that subjects incorrectly report recognizing sentences which express the implications

of antecedent material. Having encountered the boy pounded the nail to fix the birdhouse, for example, subjects later false alarm to the boy used the hammer to fix the birdhouse (Johnson et al., 1973). A second source of support has been the demonstration that implicit instruments function efficiently as recall prompts (Anderson & Ortony, 1975; Paris & Lindauer, 1976).

Singer (in press), on the other hand, has reported that subjects need significantly more time to verify test sentences that mention implicit instruments than for explicit ones (i.e., ones that had appeared in the antecedent sentence). He concluded that the inferences in question are not included in the internal representation of sentence meaning with a status equivalent to that of explicit instruments. Just and Carpenter (1977) asked whether subjects who read sentences like the millionaire was murdered were more likely to infer the existence of a killer than those who encountered the millionaire died. Because the reading times for these two sentences were equivalent, the authors tentatively concluded that this inference is not ordinarily computed during reading. Their materials included implied agents as well as instruments. It appears, in sum, that there exists evidence both supportive and contradictory of an inference-during-encoding view.

One conspicious feature of most previous studies of implicit instruments is that they have examined only those concepts which constitute, according to the experimenter's intuition, highly probable instruments for a particular action. The first experiment was designed to inspect the viability of different encoding hypotheses by examining both highly and less probable instruments (e.g., pound the nail - hammer, rock).

Sentence set (1) illustrates the antecedent-cue pairings that were constructed for the first experiment. The sentences refer to low- as well as high-preference instruments, based upon the norms of Singer (Note 1). The sentence from pair (1a), for example, refers explicitly to the high preference instrument, hammer, and the cue is hammer. In (1b), the low preference instrument, rock, is explicit; and the cue is rock; and so on.

(1) a. The worker pounded the nail with the hammer - hammer (explicit high)

b. The worker pounded the nail with the rock - rock (explicit low)

c. The worker pounded the nail through the board - hammer (implicit high)

d. The worker pounded the nail through the board - rock (implicit low)

Suppose that implied high preference instruments are, in fact, included in the internal representation of sentences. This view allows the prediction that performance will be approximately equal for explicit high preference, explicit low preference, and implicit high preference instruments; and that a lower level will be observed for implicit low preference cues. Analysis of variance should reveal a distinct Preference (high versus low) X Explicit-Implicit interaction. Main effects of Preference and Explicit-Implicit might be measured as well.

On the other hand, if implicit instruments are not stored during comprehension, then one level of cued recall performance should be observed for the two explicit conditions; and a different lower level for the implicit conditions. Analysis of variance should reveal only an Explicit-Implicit main effect.

Experiment 1

Method

Materials. The verbal materials were constructed from 12 action phrases examined in the instrument norms of Singer (Note 1). Singer asked his subjects to write the three instruments they would most expect to be used to accomplish given actions. For the present experiment, phrases were selected for which there was a large discrepancy between the most preferred and the next preferred first-choice instrument. For the phrase clear the snow, for example, shovel was the first response of 90% of the subjects. The next most frequent first choice, plow, was provided by only 3%. Across the 12 selected phrases, the average preferences were 82.0% for the most preferred and 8.8% for the next-most preferred choices.

Twelve sets of materials like set (1) were derived from these phrases. Four lists of sentences and corresponding cues were constructed from these sets in such a way that each set was passed through the four conditions representing the 2 x 2 crossing of Preference x Explicit-Implicit.

The acquisition lists consisted of 16 sentences each. They included three experimental sentences in each of the four conditions, plus four filler sentences. The fillers were included to distract subjects from the repetitive nature of the experimental items. One random order was employed for the assignment of experimental and filler sentences to list positions. For each list, there was a corresponding list of 12 cues, one for each experimental sentence. These cues appeared in the test in an order corresponding to that of the related sentences in the acquisition lists.

Subjects. The subjects were 39 male and female students of introductory psychology at the University of Manitoba. All were native speakers of English. They participated in partial fulfillment of a course requirement. The subjects

were tested in groups of size 9 through 11.

Procedure. The subjects were seated at desks and were told that that they would hear a list of unrelated sentences. After each sentence, the subjects had 10 seconds to rate the degree of activity it conveyed on a response sheet, using a 5-point scale. No mention was made of a later memory test. After rating the 16 sentences, subjects added two-digit numbers for 90 seconds, to prevent them from rehearsing the sentences and to reduce the influence of short-term memory upon the cued recall.

When the addition task was completed, the subjects received test booklets, with a different recall cue on each page. The subjects were told that each cue was intended to remind them of a sentence on the earlier list and that they should write that sentence in the booklet. They were urged to write a sentence as close in meaning to the original as possible, if they could not remember the precise wording. The subjects were given 6 self-paced minutes to complete the task and instructed never to look back in their booklets as they proceeded.

Scoring. The response to each cue received a score of 0-2, based upon the correct reproduction of the subject and object of the antecedent sentence. One point was awarded for each correct constituent. A relatively liberal recall criterion was employed, which permitted synonym and category member substitutions. Category names, however, were not accepted. The reason for this is that subjects frequently replaced the names of professions (e.g., caretaker, nurse, doctor, student) with the terms woman, man, boy, or girl. These substitutions were interpreted as reflecting subjects' inability to recall the correct item.

Results and Discussion

The proportions of correctly recalled constituents are shown in Table 1. Analysis of variance was performed upon the scores, alternately treating Subjects and Sentences as the random variable. Explicit-Implicit and Preference were within-

subjects variables in this design, while List constituted a between-subjects variable. The Subjects-random analysis revealed effects significant beyond $\alpha = .05$ for Explicit-Implicit, $F(1,34) = 7.60$; Preference $F(1,34) = 5.16$; and Explicit-Implicit x List, $F(3,34) = 7.76$. With Sentences random, however, there were no significant effects, all $ps > .10$. Although the pattern of scores is suggestive, the Explicit-Implicit x Preference interaction approached significance for neither analysis, $Fs < 1$.

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Insert Table 1 about here

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Clark (1973) has warned that results like these need to be treated with caution. The lack of agreement between the Subjects- and Sentences-random analyses prompted a closer inspection of the scores of the individual sentence sets. This revealed an unexpected relation between the following two measures: (1) the difference between the high and low preference explicit scores, and (2) the difference between high and low preference implicit scores. Consider, as an example, the scores for the phrase stir the soup. The proportions of recall were .16, .61, .11, and .50 for the high explicit, low explicit, high implicit, and low implicit conditions, respectively (the high cue was spoon and the low cue was ladle). The difference between the high and low scores for the explicit condition was -.45 (.16-.61); and for the implicit condition it was -.39 (.11-.50). Across the 12 sentence sets, these two measures showed a moderate positive correlation, $r(10) = .44$, $.10 > p > .05$.

This correlation raises questions about the mechanism by which these cues permit recall. It indicates that specific cues were similarly effective in the explicit and implicit condition. One possible reason for this is that subjects consciously or automatically computed the usual function of the instrument cues. The cue hammer would yield something like drive a nail; which in turn, could provide access to the antecedent the worker pounded the nail. This

could occur for explicit as well as implicit cues. The effectiveness of the different nouns as cues would depend upon the probability with which they evoke the corresponding actions.

To pursue this possibility, norms were collected to assess the strength of association from the instrument nouns to their corresponding actions. These will be referred to as the "backward" norms. Sixty naive subjects were asked to specify the first two actions suggested by each of 39 instrument nouns from the instrument norms (Singer, Note 1). The 24 instrument cues from Experiment 1 were included among these. The subjects were provided with three examples, like: hammer- (1) hit the nail; (2) break the window.

Special attention was paid to the cues of Experiment 1. These were scored on the basis of whether they evoked the noun of the action phrase of the sentence for which they acted as a prompt. Synonym and category member substitutions were permitted. Table 2 shows the "backward ratings" for the twelve pairs of cues. Among these pairs, high ratings were measured for every possible combination of the high and/or low preference cue, or neither. For dry the dishes, for example, the backward rating was low for both the high preference cue, towel, and the low preference cue cloth.

Insert Table 2 about here

Regression analysis was then used to assess the extent to which the instrument norms and the backward association norms predicted cued recall performance. The analysis was first applied to the scores for all sentences, and Explicit-Implicit was included in the model as a dummy predictor variable to distinguish between performance in the explicit and implicit conditions. In addition, separate analyses were run for the explicit and implicit conditions.

The correlations, regression coefficients, and the *t* values associated with

the coefficients are shown in Table 3. For the overall analysis, recall was correlated .59 with the backward norms and .26 with the instrument norms. For all three analyses, the regression coefficient for the backward norms was significant, all ps < .03; while the coefficients for the instrumental norms were not significant, all ps > .15. Finally, the analysis reflected no heterogeneity of regression coefficients between the explicit and implicit conditions $F(3,42) = .87$.

Insert Table 3 about here

If recall in Experiment 1 was based upon the "contact" between the cue and its token in the appropriate internal representation, and if subjects computed and stored highly probable implicit instruments, then performance would be positively correlated with the instrument norms, particularly for the implicit condition. These correlations, however, were not significant. In contrast, the backward association ratings did show such a high correlation with recall.

It is particularly striking that the correlation between recall and the backward norms is even larger for the explicit than the implicit condition. Regardless of the mechanism of implicit cued recall, it would seem that explicit recall cues should give subjects direct access to the token of the cue in the internal representation of the antecedent. If that were the case, however, the backward association norms should not be strongly correlated with cued recall in the explicit condition.

If subjects work backward from cue to antecedent then the present cued recall procedure cannot cast much light upon the alternate encoding hypotheses discussed earlier. The reason for this is that backward association will work successfully regardless of whether explicit or implicit instruments are included in the internal representation.

The next experiment was designed to examine a prediction based on the present findings, and to replicate a portion the findings of Experiment 1.

Experiment 2

It can be seen in Table 2 that for some of the rated action phrases, the high preferred instrument had a higher backward association rating than the low preferred; but that the opposite was true for other phrases. This distinction gave rise to one of the independent variables of Experiment 2, called Rating. This variable made reference to the member of each instrument pair (high or low preferred) that had the higher backward association rating. The second independent variable was Preference, as in Experiment 1. A cued recall procedure was again employed, but all recall cues in Experiment 2 were implicit.

If the principal mechanism of cued recall in this paradigm is backward computation at test time, then it is possible to predict an interaction between Preference and Rating. High preferred instruments should constitute more effective recall prompts than their low preference counterparts for the "high" rating sentence frames, and vice versa for the "low" frames.

Method

From the action phrases examined in the backward norming procedure, the six with the highest positive differences between the high and low preferred ratings were selected for the high Rating condition; and the six with negative differences were assigned to the low Rating condition. The Sentence variable was, accordingly, nested within Rating.

From each phrase, a set of materials like set (1) was prepared. Two lists of 16 sentences each were constructed from these sets. Each list consisted of 12 experimental and four filler items. For each list, there was a corresponding list of cues. When viewed in conjunction with the recall cues, each sentence list included three sentences in each of four conditions, representing the 2 x 2 crossing of Preference and Rating. Each action phrase occurred in the high Preference

condition in one list and the low Preference condition in the other.

The acquisition sentences consisted of only a subject, verb, and object. Since all cues were implicit, the instrument never appeared in the antecedent. The sentences, like the chef stirred the soup, were intended to be simpler than those employed in Experiment 1. One reason for this is that it was considered desirable to score the responses on the basis of the recall of the complete sentence.

The subjects were 42 male and female Grade 12 students, enrolled in college stream English courses in a Winnipeg high school. They were tested in two groups of about 20 each. These groups received acquisition lists 1 and 2, respectively.

The procedure was identical to that of Experiment 1 except in one detail. Instead of reading the test cues in their booklets, the subjects heard the recall prompts recited on tape. Each cue was repeated twice to make sure the subjects heard it. They then had 30 seconds in which to respond.

Results

The responses were scored on the basis of the recall of the complete idea expressed in the antecedent sentence, along the lines of the "meaning preserving response" procedure of Perfetti and Goldman (1974). Synonyms, cohyponyms, and category member substitutions were permitted. Table 4 shows the mean proportion of sentences recalled in each condition. With Subjects as the random variable, analysis of variance revealed that the only significant effect of interest was the predicted Preference x Rating interaction, F (1,40) = 5.34, $p < .05$. In addition, the effect of subject Group also reached significance, F (1,40) = 5.49, $p < .025$.

Because of the significant Group effect, the Sentences-random analysis was applied to scores from which these group effects were removed. This analysis revealed no significant main effects, and the Preference x Rating interaction approached

significance, F (1,10) = 3.49, .10 > p > .05.

Insert Table 4 about here

Regression analysis was applied to the Group-corrected scores. The instrumental norms and the backward norms functioned as predictor variables. The results of this analysis are shown in Table 5. Recall was correlated at .47 and .13 with the backward norms and the instrumental norms, respectively. Only the backward variable accounted for a significant proportion of the variance, t (22) = 2.48, p < .025.

Insert Table 5 about here

Discussion

The pattern of results was consistent with the prediction of a Preference x Rating interaction. The only marginal significance of the interaction for the Sentences-random analysis may be due to the relatively small number of sentence sets examined. The backward norms again emerged as the much stronger predictor of recall performance. This supports the position that the mechanism of cued recall for this paradigm is backward computation.

It is also instructive that there was no main effect of Preference. The proportions of recall for the high and low preferred cues were .33 and .29, respectively. With regard to this point, it must be remembered that the high and low cues were deliberately chosen to have highly discrepant preference as first-choice instruments. This was done to ensure the largest possible difference in the effectiveness of the two types of cue. The absence of such a difference permits two possible conclusions. The first is that low as well as highly preferred instruments are computed and stored in the in the course of sentence comprehension. The second is that the effectiveness

of implicit recall cues is based upon a mechanism of backward computation. Only the latter of these explanations is considered viable.

The repetitious nature of the materials in Experiments 1 and 2 may actually have contributed to any tendency to work backward from the cue to the antecedent. The subjects may have noticed that many of the cues functioned as instruments relative to their antecedents. Suppose a subject received the word water as an implicit cue, and that no related antecedent immediately came to mind. If one thought about how water might serve as an instrument, this extra clue might increase the probability of arriving at the correct action, dousing a fire.

To examine this possibility, a third experiment examined the agent and patient roles (or cases) as well as instruments. In addition to making backward computation more difficult, this procedure also had the advantage of greater generality with regard to the issues of inference in comprehension.

Experiment 3

Method

Materials. The construction of the verbal materials consisted of several steps. First, a pool of phrases with strong agent and patient implications was prepared. The tooth was filled, for example, implies the agent, dentist; and the pitcher threw suggests the patient, ball. A dozen phrases of each type were constructed.

The second step involved asking 58 naive undergraduate psychology students to indicate their first choice agents and patients for the appropriate phrases. Then, four phrases for each case, plus four instrument phrases, were selected; for which there was a large discrepancy between the most preferred and next preferred first-choice response. For the prisoner was sentenced, for example, the most and next preferred agents were judge (91%) and court (3%). The mean most preferred response for the 12 frames was 81.6% as compared with only 4.6%

for the next most preferred.

Set (2) provides an example of the experimental materials. The antecedent sentences were again constructed to be as simple as possible, so that subjects might reasonably be expected to respond with the complete ideas related to the test cues.

(2) a. The pupil was scolded by the teacher - teacher (explicit high)

b. The pupil was scolded by the principal - principal (explicit low)

c. The pupil was scolded - teacher (implicit high)

d. The pupil was scolded - principal (implicit low)

Using the same plan as that described for Experiment 1, it was possible to pass each sentence set though the four conditions corresponding to the 2 x 2 crossing of Explicit-Implicit and Preference. Four acquisition lists of 16 sentences each were constructed. Each list consisted of four sentences from each of the agent, patient, and instrument sets; plus four filler sentences. For each list, there was a corresponding list of 12 cues, one for each of the experimental items. The cues appeared in the same random order in each test list. The acquisition and test lists were constructed so that, of the four sentences referring to a given case, there was one for each of the four experimental conditions.

Subjects. The subjects were 27 male and female students from the same pool as that employed for Experiment 1. They were tested in groups of five to nine members.

Procedure and Design. The procedure was identical to that of Experiment 2. It should be emphasized that the materials representing the three cases were treated as a homogeneous set. Case was not considered as an independent variable because of the small number of examplars for each case. The independent variables of interest, Explicit-Implicit and Preference, were both within-subject

variables.

Results

The responses were scored using the meaning preserving criterion of Experiment 2. The proportions of correct responses for the four conditions are shown in Table 6. The only significant effect of interest was that of Explicit-Implicit, F (1,23) = 15.9, $p < .01$, with Subjects random; and $F(1,11) = 15.8$, $p < .01$, with Sentences random. This effect reflected recall rates of 58.0% and 36.4% for the explicit and implicit conditions respectively. The Explicit-Implicit x Preference interaction did not approach significance, $Fs < 1$. The only other effect that reached significance was that of Group in the Subjects-random analysis.

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Insert Table 6 about here
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Correlations were measured between the instrument norms for these materials and recall performance. Values of .14 and .16 were obtained for the explicit and implicit conditions, respectively. While there were no backward norms for the agent and patient sets, the backward norms for the four instrument sets correlated $r(6) = .61$ and .65 with performance for the explicit and implicit conditions respectively (the critical cut off for $\alpha = .05$ is $r(6) = .62$). Furthermore, the correlation was again measured (as for Experiment 1) between (1) (explicit high - explicit low performance) and (2) (implicit high - implicit low performance). The computation yielded a value of r (10) = .46, $.10 \geq p > .05$.

Discussion

There are several points worth noting about these results. First, the Test Status x Preference interaction that would be consistent with an inference-during-encoding position again did not appear. This is true despite the fact that the materials were purposely constructed so as to maximize the differences in preference between the high and low preference elements. If the implicit

cues permitted recall by making contact with their tokens in the internal representation of the antecedent, then high implicit cues should have been much more effective than their low implicit counterparts, leading to the observation of an Explicit-Implicit x Preference interaction.

Second, the instrument norms again correlated only very weakly with both explicit and implicit performance; while those backward norms that were available constituted more effective predictors. Thus, despite the fact that the recall cues played a variety of roles in relation to their antecedents, the general pattern of results obtained is consistent with the findings of Experiments 1 and 2.

A third result of particular interest was the detection of a much stronger Explicit-Implicit effect than that measured for Experiment 1. As suggested earlier, it may be that the implicit cues of the first two experiments were especially effective because subjects discerned that many of the them functioned as instruments. The absence of this hint may have contributed to the emergence of a sizable Test Status effect in Experiment 3[1]. In spite of this, other aspects of the results submit to similar interpretations as seemed appropriate for Experiment 1.

General Discussion

Implicit or extra-list cued recall was first employed in the study of list learning, and it has received careful examination in that context (e.g., Bilodeau & Blick, 1965; Thompson & Tulving, 1970; Tulving & Thompson, 1973). In its application to the study of sentence comprehension, the underlying rationale has been that if an implicit cue functions as an effective recall prompt, it may be concluded that the corresponding inference was computed and stored earlier. While the converse of this argument seems sound (i.e., if an inference is computed and stored during comprehension, the word(s) corresponding to this inference should effectively cue recall), the argument itself does not.

Rather than providing direct access to an element of the stored representation, the present data suggest that implicit cues permit the subject to work backwards toward an element that had occurred explicitly in the target antecedent sentence; which in turn provides access to the representation.

Having recognized this possibility, investigators have compared the level of implicit cued recall of sentences, with the level predicted on the basis of the associative strength from the cue to the sentence constituents. In two studies in particular, it was reported that implicit cued recall exceeded the level predicted on the basis of simple associations (Anderson & Ortony, 1975; Till, 1977). Till (1977) was able to make this demonstration with cues that seem to label the event described in a sentence[2] (e.g., prank as a cue for the students removed the chalk). In another experiment in the same study, however, many of the cues functioned as instruments. In that experiment, the level of cued recall performance was predicted very accurately by a simple associative model.

There is also an element of Anderson and Ortony's (1975) data which reflects the power of simple associations in this paradigm. The authors were primarily concerned with the effectiveness of an implicit cue like odds for antecedents like coins can be flipped. The cue was supposed to represent emergent or contextual properties of the related sentence. Cued recall performance was compared with the effectiveness of the implicit cue for sentences like coins are difficult to forge ("subject control"), pancakes can be flipped ("predicate control"), and signatures are difficult to forge ("double control"). Of relevance to the present study is the fact that implicit cues provided access to the subject control sentences, for example, from 27% to 50% of the time, depending on the scoring procedures. This level of performance, furthermore, was not due simply to the subject being forced to

choose a response from a small list of possible antecedents. If it were, then subjects would have performed moderately well on double controls, too. For this condition, however, subjects scored from 0% to 1% correct.

Corbett and Dosher (1978) have independently conducted a study similar to the present one, and report results consistent with the general conclusions of this paper. Two features of their findings are of special interest. First, they included a condition in which the high preference instrument served as a cue for an antecedent in which the low preference instrument had been explicit (e.g., hammer as a cue for the worker hit the nail with the rock). The authors argued that there was no reason for subjects to have inferred the use of the high preference instrument for such an antecedent. It was found, however, that the high preference instrument was as effective a prompt in this condition as in conditions in which the high preference instrument or no instrument at all had occurred in acquisition. It was concluded that effective implicit cued recall does not necessarily indicate that the related inference has been drawn in acquisition.

Second, Corbett and Dosher provided some direct evidence that implicit instruments are not inferred in comprehension. Their subjects were carefully instructed to include the instrument cue in their written recall only if it had occurred in acquisition. It was argued that if implicit instruments are computed in the course of comprehension, they should frequently be included in the response. Corbett and Dosher found that, even after a 30 minute delay, subjects wrote down the high preference instrument four times as often when it had occurred in acquisition as when no instrument had appeared.

To summarize briefly, the present study set out to examine alternate hypotheses with regard to the computation of inferences in the course of sentence comprehension. A cued recall procedure was employed. Two aspects of the results

are of particular note. First, it was suggested that the computation of high preference instruments would permit the observation of an Explicit-Implicit X Preference interaction. In Experiments 1 and 3, however, this interaction was not detected; and in Experiment 2, in which Explicit-Implicit was not a variable there was no difference in the effectiveness of high and low preferred cues.

Second, the association strength from instrument cues to their related actions acted as a much stronger predictor of cued recall performance than did the degree of preference for the instruments. This association strength was significantly correlated with performance in the explicit as well as the implicit test condition. It is concluded that the effectiveness of both explicit and implicit recall cues can be better explained in terms of a conscious or automatic backward computation mechanism than in terms of contact between cue and token. The effectiveness of an implicit recall cue cannot, accordingly, be interpreted as strong evidence of the prior computation of a corresponding inference.

Footnotes

Identification footnote.

The data described in this paper were presented in a symposium titled, "Implication and Inference in Language Comprehension," at the meeting of the American Psychological Association, Toronto, August, 1978. The research was supported by a grant from the National Research Council of Canada, #A9800. I am very grateful to Mr. George Phillips, principal, Mr. Jim Duncan, and several other staff members who made it possible for us to collect data for this study at Kelvin High School in Winnipeg. I would also like to thank John McIntyre for his comments on an earlier draft of this paper; and Cyril Fong-Man, who assisted in the data collection. Reprints requests should be addressed to M. Singer, Department of Psychology, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

1. The proportion of correct responses was considerably higher for Experiment 3 than 1. This can probably be attributed to the fact that simpler antecedents were employed in Experiment 3.

2. In their model of text comprehension, Kintsch and Van Dijk (1978) propose the existence of "macro-operators" which permit the generalization or deletion of the propositions conveyed in discourse, before a representation of the message is ultimately stored. The effectiveness of prank for the students removed the chalk might be understood in terms of the generalization of (REMOVE, STUDENTS, CHALK) to something like (DO, STUDENTS, PRANK).

Reference Notes

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Table 1

Proportion of Accurately Recalled Constituents in Experiment 1

Preference	Explicit	Implicit
High	.42	.38
Low	.38	.25

Table 2

Proportion of Associations from Cue

to Noun of Corresponding Action

Target	"High" Cue	Proportion	"Low" Cue	Proportion
douse the bonfire	water	.00	hose	.05
clear the snow	shovel	.58	plow	.00
cut the grass	mower	.75	shears	.37
light the candle	match	.08	lighter	.02
tie the package	string	.31	ribbon	.17
row the boat	oars	.88	paddles	.68
trim someone's hair	scissors	.17	razor	.05
shoot the deer	gun	.05	rifle	.23
dry the dishes	towel	.05	cloth	.05
stir the soup	spoon	.33	ladle	.75
spread the paint	brush	.02	roller	.00
mark the exam	pen	.15	pencil	.17

Table 3

Results of Regression Analysis for Experiment 1

Analysis	Predictor	Correlation	Regression Coefficient	Coefficient t
Explicit	Instrumental	.21	.07	.64
	Backward	.70	.65	4.4[a]
Implicit	Instrumental	.32	.17	1.3
	Backward	.48	.41	2.4[a]
Overall	Instrumental	.26	.12	1.4
	Backward	.59	.53	4.7[a]

[a] $p \leq .03$

Table 4

Proportion of Accurately Recalled Sentences in Experiment 2

	Preference	
Rating	High	Low
High	.37	.24
Low	.29	.35

Table 5

Results of Regression Analysis for Experiment 2

Predictor	Correlation	Regression Coefficient	t
Instrumental	.13	.06	.72
Backward	.47	.26	2.5[a]

[a] $p \leq .03$

Table 6

Proportion of Accurately Recalled

Sentences in Experiment 3

Preference	Explicit	Implicit
High	.58	.41
Low	.58	.32